



National Unit Specification: general information

UNIT Earthing and Earth Fault Current Protection (SCQF level 6)

CODE F5HD 12

SUMMARY

This Unit is intended for candidates with little or no prior knowledge of earthing systems for electrical installations, and the protection of persons against the dangers of earth fault currents.

The aim of this Unit is to develop the candidate's knowledge and understanding of the various types of earthing system and the requirements of the Wiring Regulations BS7671 in relation to earthing and earth fault current protection. The Unit will introduce candidates to different methods of fault protection and to the types of earthing arrangement outlined in BS7671. Candidates will be able to select appropriate sizes of earth protective conductors, bonding conductors and a circuit protective device for given installation conditions. Candidates will also be introduced to Residual Current Devices (RCD) as a means of disconnecting the supply in the event of a fault to earth.

This Unit may form part of a National Qualification Group Award or may be offered on a free-standing basis.

OUTCOMES

- 1 Describe the dangers of earth fault currents and the features of fault protection methods.
- 2 Describe the different types of earthing arrangement in terms of the Wiring Regulations BS7671.
- 3 Determine the BS7671 requirements for the 'Automatic Disconnection of Supply' protective measure, including protective equipotential bonding, for a given electrical installation using the TN-C-S earthing system.
- 4 Describe the use of a residual current device (RCD) as a means of additional protection against faults.

Administrative Information

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RECOMMENDED ENTRY

While entry is at the discretion of the centre, candidates would normally be expected to have attained one of the following, or equivalent:

- ◆ Standard Grade Mathematics — Credit Level
- ◆ Standard Grade Technological Studies — Credit Level
- ◆ Standard Grade Physics — Credit Level
- ◆ NQ Unit *Earthing Systems* (SCQF level 5)

CREDIT VALUE

1 credit at SCQF level 6 (6 SCQF credit points at SCQF level 6*).

**SCQF credit points are used to allocate credit to qualifications in the Scottish Credit and Qualifications Framework (SCQF). Each qualification in the Framework is allocated a number of SCQF credit points at an SCQF level. There are 12 SCQF levels, ranging from Access 1 to Doctorates.*

CORE SKILLS

There is no automatic certification of Core Skills in this Unit.

This Unit provides opportunities for candidates to develop aspects of the following Core Skill:

- ◆ Numeracy (SCQF level 6)

These opportunities are highlighted in the Support Notes of this Unit Specification.

National Unit Specification: statement of standards

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Acceptable performance in this Unit will be the satisfactory achievement of the standards set out in this part of the Unit Specification. All sections of the statement of standards are mandatory and cannot be altered without reference to SQA.

OUTCOME 1

Describe the dangers of earth fault currents and the features of fault protection methods.

Performance Criteria

- (a) Describe correctly the dangers resulting from earth fault currents.
- (b) Define correctly the terminology relating to earthing and earth fault current protection.
- (c) Identify correctly the methods of fault protection as given in the Wiring Regulations BS7671.
- (d) Explain clearly the features of the various fault protection methods given in BS7671.

OUTCOME 2

Describe the different types of earthing arrangement in terms of the Wiring Regulations BS7671.

Performance Criteria

- (a) Identify correctly TN-C, TN-S, TN-C-S and TT earthing systems from given diagrams.
- (b) Describe correctly the distinguishing features of TN-C, TN-S, TN-C-S and TT earthing systems.

OUTCOME 3

Determine the BS7671 requirements for the 'Automatic Disconnection of Supply' protective measure, including protective equipotential bonding, for a given electrical installation using the TN-C-S earthing system.

Performance Criteria

- (a) Describe correctly the protective equipotential bonding requirements of an automatic disconnection of supply arrangement, for a given electrical installation, in accordance with BS7671.
- (b) Determine correctly the earth fault loop impedance value for a given electrical installation, in accordance with the requirements of BS7671.
- (c) Determine correctly the size of protective conductors for a given electrical installation, in accordance with the requirements of BS7671.
- (d) Determine correctly the rating of the protective device for a given electrical installation in accordance with the requirements of BS7671.

National Unit Specification: statement of standards (cont)

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OUTCOME 4

Describe the use of a residual current device (RCD) as a means of additional protection against faults.

Performance Criteria

- (a) Define correctly the term 'Residual Current Device' as given in BS7671.
- (b) Describe the operation of an RCD as a means of additional protection against fault currents.
- (c) Describe correctly the requirements of BS7671 relating to the use of an RCD as a means of additional protection against faults.

EVIDENCE REQUIREMENTS FOR THIS UNIT

Evidence is required to demonstrate that candidates have achieved all Outcomes and Performance Criteria.

Written and/or recorded oral evidence should be produced to demonstrate that the candidate has achieved all the Outcomes and Performance Criteria. The evidence should be produced under supervised, controlled conditions. Candidates should be permitted to use the Wiring Regulations BS7671 as a reference document but should not be allowed to use any other notes or learning materials during the assessment of this Unit.

An appropriate form of assessment could be a single, holistic exercise incorporating all the Outcomes and Performance Criteria. Alternatively, a series of assessment exercises may be used to produce evidence for each Outcome or combination of Outcomes. The total assessment time should be no more than two hours irrespective of the Assessment approach used.

With regard to Outcome 1:

- ◆ six earthing and earth fault protection terms to be defined
- ◆ methods of fault protection only to be identified
- ◆ three features of each fault protection method only to be explained

With regard to Outcome 3:

- ◆ six bonding requirements to be described
- ◆ the earth fault loop impedance should be calculated for one circuit only by calculation
- ◆ the size of protective conductors should be produced by both calculation and selection as appropriate in terms of the requirements of BS7671
- ◆ the protective device should be selected in accordance with the requirements of BS7671

With regard to Outcome 4:

- ◆ six BS7671 requirements for RCDs should be described

The Assessment Support Pack for this Unit provides sample assessment material. Centres wishing to develop their own assessments should refer to the Assessment Support Pack to ensure a comparable standard.

National Unit Specification: support notes

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This part of the Unit Specification is offered as guidance. The support notes are not mandatory.

While the exact time allocated to this Unit is at the discretion of the centre, the notional design length is 40 hours.

GUIDANCE ON THE CONTENT AND CONTEXT FOR THIS UNIT

This is a restricted core Unit within the National Qualification Group Award in Electrical Engineering at SCQF level 6, but may also be offered on a free -standing basis.

The aim of this Unit is to develop the candidate's knowledge and understanding of the various types of earthing system and the requirements of the Wiring Regulations BS7671 in relation to earthing and earth fault current protection.

Candidates will be able to describe the effects and dangers of earth fault currents and the need to protect persons from electric shock due to fault conditions. They will be introduced to different methods of protection against fault conditions and to the types of earthing arrangement outlined in BS7671.

Candidates will be able to both calculate and select, using the criteria of BS7671, appropriate sizes of earth protective conductors, bonding conductors and a circuit protective device for given installation conditions. Candidates will also be introduced to Residual Current Devices (RCD) as a means of disconnecting the supply in the event of a fault to earth and will understand the need for and the operating principles of such devices.

The content and context of this Unit should provide candidates with an overview of the earthing and earth fault current protection systems and set this topic in a practical context for given types of wiring system and location of the installation.

The requirements of BS7671 should be emphasised in relation to earthing and candidates should be given opportunities to calculate appropriate values of earth fault loop impedance (Z_s) and the cross-sectional area of protective conductors to determine compliance with the thermal and shock constraints for a given installation.

GUIDANCE ON LEARNING AND TEACHING APPROACHES FOR THIS UNIT

Although much of the content of this Unit is of a descriptive nature, it should be delivered in an electrical installation environment. This could be in a classroom, laboratory or workshop in which the environmental emphasis is placed on electrical installation and earthing systems.

Delivery of the Unit content could utilize relevant industrial case studies, and drawings/layouts and specifications of electrical installations. The use of relevant videos or DVD recordings illustrating the principles of electric shock protection methods would be useful.

National Unit Specification: support notes (cont)

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The use of BS7671 as a working document should be encouraged and candidates should be given exercises which provide opportunities for them to use the relevant sections of this publication.

Candidates should be encouraged to discuss the various issues raised by the subject content in order that this interaction might stimulate their thought processes and reinforce the learning.

It is recommended that the Outcomes be delivered in the sequence given in the 'statement of standards'.

OPPORTUNITIES FOR CORE SKILL DEVELOPMENT

As they select sizes of conductors and a circuit protective device appropriate for installation conditions candidates interpret and perform a series of complex calculations and measurements using the criteria of BS7671. Numeracy skills will be naturally enhanced, with the focus on practical interpretation and application of data. Formative activities should be designed to develop accuracy and confidence in handling graphic and numerical concepts in a practical electrical engineering context.

GUIDANCE ON APPROACHES TO ASSESSMENT FOR THIS UNIT

Opportunities for the use of e-assessment

E-assessment may be appropriate for some assessments in this Unit. By e-assessment we mean assessment which is supported by information and communications technology (ICT), such as e-testing or the use of e-portfolios or e-checklists. Centres which wish to use e-assessment must ensure that the national standard is applied to all candidate evidence and that conditions of assessment as specified in the Evidence Requirements are met, regardless of the mode of gathering evidence. Further advice is available in *SQA Guidelines on Online Assessment for Further Education (AA1641, March 2003)*, *SQA Guidelines on e-assessment for Schools (BD2625, June 2005)*.

The assessment of this Unit could take the form of a holistic exercise of short-answer, restricted response and structured questions, covering the Performance Criteria specified in the Unit Outcomes ie:

- ◆ the dangers of earth fault current and the features of fault protection methods
- ◆ the different types of earthing arrangement in terms of the Wiring Regulations BS7671
- ◆ the requirements of an Automatic Disconnection of Supply protection arrangement, including protective equipotential bonding, for a given electrical installation using the TN-C-S earthing system
- ◆ the use of a residual current device (RCD) as a means of additional protection against faults

Alternatively, four separate or any combination of exercises, may be produced, to cover all of the Performance Criteria contained within the Outcomes.

The total assessment time for this Unit should be no longer than two hours, this being the resultant time if Outcomes are assessed on an individual basis. It is recommended that one hour be allocated to the assessment of Outcome 3.

National Unit Specification: support notes (cont)

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CANDIDATES WITH DISABILITIES AND/OR ADDITIONAL SUPPORT NEEDS

The additional support needs of individual candidates should be taken into account when planning learning experiences, selecting assessment instruments, or considering alternative Outcomes for Units. Further advice can be found in the SQA document *Guidance on Assessment Arrangements for Candidates with Disabilities and/or Additional Support Needs* (www.sqa.org.uk).